EXPERIMENTAL INVESTIGATION OF NUCLEAR ISOMERS

BY

JEHUDA OVADIA

B.A., Brooklyn College, 1944
M.S., University of Illinois, 1947

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN PHYSICS
IN THE GRADUATE COLLEGE OF THE
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Improvements in the theories of nulcear isomers and nuclear shell structure have been recently proposed and calculations of internal conversion coefficients have been carried out. They lead to discrepancies between theoretical calculations and some experimental results reported in the literature. The investigations were carried out on the activities of titanium 51, silver 109 and niobium 91.

A long lived activity in titanium 51 had been attributed to an isomeric transition. It was analyzed with a magnetic lens beta ray spectrometer. The results obtained here confirm the conclusion arrived at by a different group of investigators who attribute the activity to impurities of hafnium 181 and antimony 124. The absence of an isomeric transition in titanium 51 is in agreement with the prediction of shell theory.

The 40 second isomeric state in silver 109 decays by emission of a highly converted $87.7 \pm .3$ kev gamma ray. This state was arrived at from the decay of the $13.4 \pm .3$ hour palladium 109 with emission of a $1.02 \pm .02$ Mev beta. The intensity of the beta spectrum and conversion electron spectrum are equal within experimental error, and the decay scheme is thus simple. The K conversion coefficint is 8.5 ± 2. It was obtaind by comparing the intensity of the K x-rays and of the gamma rays, using high pressure geiger counters and sodium iodide scintillation counters as detectors. The K to $(L + M)$ ratio is $.80 \pm .05$. These results confirm one of the previously reported values.

It is not possible to assign a unique multipole order to the radiation, which would satisfy all theories as they now stand. According to the findings of Sunyar and Goldhaber, this transition is classified as electric 2^3 pole, using the value of the K conversion coefficient as a criterion. The experimental values of the K to L ratio, of the gamma ray half life and of the

multipole order of the transition, are then found in agreement with their empirical modifications of present theories of nuclear isomers and nuclear shell structure.

The 64 day activity in niobium 91 arises from a 105 ± 1.5 kev isomeric state. The K to $(L + M)$ ratio of the conversion electrons is $2.5 \pm .5$. The K conversion coefficient was also measured by comparing the intensity of the K x-ray and gamma ray; it was found to equal 70 ± 20. This value is too low by a factor of two from an approximate calculation of the K conversion coefficient for magnetic 2^4 pole radiation. However the gamma ray half life agrees with such an assignment which is also predicted by shell theory. Since there are some questionable aspects of the experiment and since the theoretical value is an extrapolated approximation, this conversion coefficient discrepancy is not yet considered serious.

VITA

Jehuda Ovadia was born in Vienna (Austria) on November 16, 1923. He received his primary and secondary education in Paris (France) and obtained his baccalauréat d'études secondaires from the "Lycée Français de New York" in June 1941. He attended Brooklyn College from September 1941 to February 1944 when he received his Bachelor of Arts degree in physics. He served in the United States Navy from February 1944 to February 1946. Upon discharge from the Navy, he entered the Graduate College of the University of Illinois. He was continually employed as a teaching or research assistant. In June 1947 he received the degree of Master of Science in physics.

He is a member of Sigma Xi and is associated with the American Physical Society.

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